

Claims

1. A control valve comprising the combination of an inner sleeve having a cylindrical outside surface and a cylindrical inside surface that encloses a chamber about a longitudinal axis, a zinc-air battery within the chamber, the battery being comprised of zinc which produces electrical current responsive to ingress of air into the battery, an outer sleeve having a cylindrical inside surface mounted in sliding contact on the outer surface of the inner sleeve, the inner sleeve further being mounted for reciprocating movement along the longitudinal axis between first and second axially spaced positions relative to the outer sleeve, first and second actuators, each actuator being formed of a shape memory alloy material having a crystalline phase change transition temperature and in which the actuators change shape by contraction responsive to being heated through their respective transition temperatures, a control circuit for heating the actuators through the transition temperatures, the first and second actuators being operatively connected in opposition with the inner sleeve for alternatively moving the inner sleeve between the first and second positions, the inner sleeve being formed with a plurality of first openings and the outer sleeve being formed with a plurality of second openings which substantially register with the first openings for opening a flow of the fluid therethrough when the inner sleeve is in the first position and further in which the second openings are substantially out of register with the first openings for closing the flow when the inner sleeve is in the second position, and a control mechanism for disabling actuation of the first or second actuator while enabling actuation of the respective second or first actuator.
2. A control valve as in claim 1 in which the control mechanism comprises a bistable latch for releasably holding the inner sleeve alternatively in the first or second positions.
3. A control valve as in claim 2 in which the bistable latch is connected with the inner sleeve, the latch changing shape toward a first bistable position responsive to

movement of the inner sleeve to the first position and the latch further changing shape toward a second bistable position responsive to movement of the inner sleeve to the second position.

4. A control valve as in claim 3 in which the control circuit comprises a switch which is enabled in one switching mode for connecting the first actuator to an electric power source for resistance heating responsive to movement of the latch to the first bistable position while disconnecting the second actuator from the power source, and the switch is enabled in an other switching mode for connecting the second actuator to the power source responsive to movement of the latch to the second bistable position while disconnecting the first actuator from the power source.

5. A control valve as in claim 1 in which the first actuator has one end mounted to the inner sleeve and an opposite end mounted to the outer sleeve sufficient to cause movement of the inner sleeve to the first position responsive to contraction of the first actuator, and the second actuator has one end mounted to the inner sleeve and an opposite end mounted to the outer sleeve sufficient to cause movement of the inner sleeve to the second position responsive to contraction of the second actuator.